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Research on Corporate Hedging Theories: A Critical Review of the Evidence to Date

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ABSTRACT

This paper provides a critical review of three common problems facing researchers when implementing tests of corporate hedging theories: (1) how to identify hedgers in the population considered? (2) how to measure corporate hedging and finally, (3) what possible determinants should be considered in the test and, how to measure them? We identify the most popular approaches in the literature to tackle these issues and show that each approach offers its advantages but has also its own limits. More importantly, we show that the different variables used to measure corporate hedging rationales could proxy for more than one argument at a time. Accordingly, results drawn from the tests should be interpreted with caution. Considering the additional arguments developed recently to justify corporate hedging, and the greater availability of data on such activity, we argue that the need for cleaner proxies in the risk management literature is more important than ever.

Keywords: Corporate hedging theories, tests, hedger identification, measures of corporate hedging, determinants of corporate hedging.

JEL classification: G 18, G 30.

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Introduction

The last two decades have witnessed a dramatic increase in the number of research studies seeking to explain why firms hedge. This literature mainly focused on non-financial firms because the financial ones are considered as users and providers of hedging instruments and consequently could have different factors affecting their risk management strategies. On the theoretical side, several arguments have been put forward to explain why corporate risk management activities are value-enhancing. These explanations rely mainly on the introduction of some frictions to the Modigliani and Miller (1958) framework[1]. The predicted power of these theories was tested in numerous papers but, unfortunately, there is not yet a unique, well accepted framework that practitioners can rely on when setting their risk management strategies. It should be mentioned that empirical examination of hedging theories has been hindered by the lack of quality data on corporate hedging in widely used databases and publicly available documents. Fortunately, this situation is improving, largely because of the mandatory disclosure of information on risk management in annual reports and other financial statements amended by the new regulation. However despite this improvement in data availability, information on corporate hedging is still harder to get than other financial data.

When conducting a test of corporate hedging theories, one should realize that having data on risk management operations does not eliminate all the problems associated with the implementation of the test. Indeed, additional issues have to be solved in order to get things done. Technically speaking the following three questions must be answered: (1) how to identify hedgers in the population considered? (2) how to measure corporate hedging and finally, (3) what possible determinants should be considered in the test and, how to measure them? Of course, the plethora of papers that investigated risk management determinants provided their own answers to these questions and sometimes more than one.

The objective of this paper is to review the different solutions provided during the last two decades in the risk management literature to the questions above mentioned. We think that, by reviewing previous work on this topic, we can improve the quality of future tests on risk management determinants. In the present context, these tests are important for two main reasons. First, the number of firms hedging their risks is constantly increasing. Indeed, according, to the 1998 Wharton survey of financial risk management by US non-financial firms conducted by Bodnar et al. (1998), more than 50% of

respondent firms used derivatives in 1998 compared to 41% in 1995 and 35% in 1994. We think that it is time to understand why firms are so attracted by corporate hedging especially that, better quality data, needed for the tests is more available. Second, new rules regulating risk management were recently introduced[2] and we expect additional regulation on this activity in the near future. Recall that risk management affects considerably the firm's performance and consists usually in off-balance sheet operations which could be more easily manipulated by managers. Accordingly, it is probable that new requirements on the disclosure and the setting of risk management operations will be introduced in order to avoid financial scandals and abuses. A better understanding of the factors affecting corporate hedging will help provide an adequate regulation for this activity. Our goal in this paper is to provide researchers with a reference that shows the advantages and drawbacks of previous approaches in order to help them avoid some pitfalls associated with the implementation of corporate hedging theories tests.

We draw two main conclusions from our review of the literature on risk management determinants. First, there is still a lot of work to do in order to improve measures of corporate hedging as well as variables proxying the rationales for corporate risk management. Several variables presently used in the tests proxy for more than one argument. This complicates the interpretation of the results and makes tests less powerful. Also, recently, new explanations for corporate hedging, based on internal corporate governance mechanisms and country-specific characteristics, were offered in the literature. Thus, in addition to the traditional theories for which proxies should be improved, we have to define new proxies for these arguments. Therefore, the need for cleaner proxies in the risk management literature is more important than ever.

Second, there is a lot of confusion surrounding the interpretation of results reported in tests of risk management determinants. In the introduction of almost every paper we read, there was a reference to the little consensus regarding the validity of corporate hedging theories and the mixed empirical results reported by tests of these theories. We think it is important to remember, when comparing results from these papers, that often these tests are not investigating identical empirical questions. Using discrepancies in results between a paper that investigates the determinants of the decision to hedge and another paper that investigates the determinants of the hedging ratio to invalidate risk management theories is incorrect. Such behaviour does not recognize that these two corporate decisions might have

[1] See for example the seminal articles of Stulz (1984), Smith and Stulz (1985), Stulz (1990), DeMarzo and Duffie (1991; 1995), Breeden and Viswanathan (1998), Froot, Scharfstein and Stein (1993) and Morellec and Smith (2002).
[2] Refer to section 303A.07 (D) of the final NYSE corporate governance rules available in the NYSE's listed company manual.

different factors affecting them. Several papers provide support for this argument: Mardsen and Prevost (2005) for all risks, Haushalter (2000) for commodity risk and Allayannis and Ofek (2001) for currency risk. Also, one should remember that all the tests of corporate hedging theories do not consider the same type of risk. It is possible that risk management of foreign exchange risk (FX hereafter) is determined by factors different from the ones affecting risk management of interest rate risk (IR hereafter) or commodity risk (CR hereafter). Howton and Perfect (1998), Bartram, et al. (2004) and Nguyen and Faff (2003) provide support for this argument. Accordingly, results should be compared only if they concern the same decision and risk type.

Finally, one intriguing fact that hits us when reviewing papers that tested empirically corporate hedging theories during the 1985-2005 period is the lack of recent datasets in the tests. Over the twenty papers written between 2000 and 2005, only two papers [Nguyen and Faff, 2003; Bartram et al., 2004] use data concerning year 2000 and beyond. This fact is surprising because data became more available and richer during these previous years thanks to the disclosure requirements set by regulators. We think it is interesting to test corporate hedging theories with more recent datasets in order to verify the stability in time of risk management determinants.

The remainder of the paper is structured as follows. Section I reviews the different approaches used in the literature to identify hedgers. In section II we describe the most popular measures for corporate hedging. Section III contains the different arguments proposed in the literature to explain why firms hedge as well as the most common variables proxying these rationales. Section IV concludes the paper.

I. How to identify hedgers?

A major issue when implementing a test of risk management determinants is how to identify "hedgers" in the population considered. Basically, three main approaches were explored in the literature: direct surveys, keyword search of public documents and private datasets.

(Insert Table I here)

A. The survey approach

In the absence of information about risk management activities, earlier papers conducted surveys to identify hedgers. The most commonly asked question in these surveys is whether the firm uses

derivatives instruments during a given period[3] [Block and Gallagher, 1986; Nance, Smith and Smithson, 1993; Jalilvand, 1999; Bodnar, Jon and Macrae, 2003]. Surveys usually provide rich data that is sometimes impossible to get by other means. For example the researcher can ask questions about the motivations behind the risk management operations in the firm. Also, if the researcher has a privileged contact within the firms surveyed or sends the questionnaire through official organizations, things can go pretty fast.

Unfortunately, results reported with this approach probably suffer from the non-response bias typical of survey samples. Indeed, hedgers may have greater incentive to respond to these surveys than non-hedgers. Consequently, there is no guarantee that the sample of respondents companies reflects properly the characteristics of the considered population. This problem is very important mainly when the tests results are needed for legislation purposes. Haulshalter (2000) shows that the non-respondent firms in his survey have fewer assets than the firms that made it to his sample. This finding confirms the existence of a sampling bias in survey data. Furthermore, answers to risk management surveys are usually provided by the firm's CEO, CFO or treasurer, which make them affected by their perception of the firm. It is important to remember also that, in most cases, there is no way to verify the reliability of the answers provided by the survey.

B. The keyword search approach

"Hedgers" could also be identified by searching the firm's financial documents (annual and quarterly reports…) for keywords like risk management, hedging, derivatives, options, futures, swap…etc. As Table I shows, this approach is used by 42% of the papers we reviewed. The annual reports can be searched on the SEC website for companies listed in US exchanges and SEDAR website for Canadian public companies. They are also available on the NAARS files available on Lexis-Nexis [Mian, 1996], Disclosure database [Dolde and Mishra, 2002] as well as data provided by Thompson Research [Lel, 2004]. The keyword search approach became popular recently thanks to the availability of richer data on risk management activity in the firms' annual reports.

However, a potential problem related to this method is that it may underestimate the number of hedgers. Indeed, firms that hedge their risks but do not disclose this information in their public

[3] Haushalter (2000) also conduct a survey in which he asks the respondents to provide the proportion of their production being hedged.

documents will be classified as non-hedgers. This will add noise to the results. Also, this approach is time consuming when the sample size is large.

In the United States, the increase in data availability is encouraged by the FASB disclosure requirements. The first step toward more transparency about firms' derivative usage was provided by SFAS 105, *Disclosure of Information about Financial Instruments with Off-Balance-Sheet Risk and Financial Instruments with Concentrations of Credit Risk*. SFAS 105 required firms to disclose information about financial instruments, not just derivatives, which create off-balance risk as well as credit risk from financial transactions for fiscal years starting after June 15th, 1990. Among others, firms are required to report information about the face, contract, or notional amount of these instruments as well as information about their credit and market risk. Firms are not however required to disclose information concerning the direction of the hedge. SFAS 107, *disclosures about Fair Value of Financial Instruments,* issued in late 1991, put additional disclosure requirements about the fair value of financial instruments in the statement of financial position, for which it is practicable to estimate fair value. SFAS 107 was effective for fiscal years ending after December 15, 1992 except for firms whose total assets is less than 150 Millions $, for whom the requirement is effective for fiscal years ending after December 15, 1995. In 1994, the FASB issued SFAS 119, *Disclosure about Derivative Financial Instruments and Fair Value of Financial Instruments*, which improved considerably the quality of data on corporate hedging available in annual reports. This statement requires firms to disclose information about amounts, nature, and terms of their derivatives instruments that are not subject to Statement 105 because they do not result in off-balance risk. SFAS 119 also requires firms to disclose whether the instruments are held for hedging or for other purposes. More importantly, it requires firms to disaggregate information about their financial instruments with off-balance risk by class, business activity, risk, or other category that is consistent with their management of those instruments. SFAS 119 was effective for fiscal years ending after December 15, 1994, except for firms with less than $150 million in total assets. These firms must comply with SFAS 119 for fiscal years ending after December 15, 1995.

C. The private dataset approach

The third approach proposed in the literature to identify "hedgers" consists in using already collected information about risk management activities. Commonly, the firms mentioned in the datasource are identified as hedgers. Two possible alternatives were explored in previous research. The first alternative consists in getting data from investment companies, brokers or analysts who compiled

information about corporate hedging for their own interests. As Table I shows, Tufano (1996), Dionne and Garand (2003), Dionne and Triki (2004, 2005), and Brown, Crabb and Haushalter (2003) work with detailed data relative to a sample of gold mining firms that was collected by a Canadian analyst called Ted Reeve. Mr. Reeve compiled, between 1991 and 1999, the data when he used to cover precious metals firms for Scotia Capital. Like in the survey case, there is no way to verify the reliability of the data but the fact that it was collected by a person who has insider information gives it credibility.

The second alternative explored in this approach consists in using paying databases such as the "*Database of users of derivatives*" [Gay and Nam, 1998; Lin and Smith, 2003; Knopf, Nam and Thornton, 2002; DaDalt, Gay and Nam, 2002], the "*Handbook of users of off-balance sheet instruments*" [Fok, Carroll and Chiou, 1997][4] or the "*Corporate Risk Management Handbook*" [Borokhovich et al., 2004]. The first two publications are offered by Swaps Monitor Publications and provide, among others, information about the notional amounts and market values of interest rate, currency and commodity derivatives. The Interest rate and currency edition of these databases covers 3400 companies (including 1698 corporations) while the commodity edition covers 550 companies (including 457 corporations). The advantage of the database version is that it provides the notional values by instrument type and by category. It also assigns a "-1" code to hedgers for whom the notional amount is unavailable. This codification should reduce errors when discriminating between hedgers and non hedgers. Unfortunately, Swaps Monitor Publications ceased to provide these products in 1997 which will limit the sampling period for someone who wants to work with these datasources. Also, data available in these databases concerns only American companies. The "*Corporate Risk Management Handbook*" provides details, for S&P 500 companies, on the notional amounts of each type of derivatives[5]. There is however two limits associated with this source. First, the handbook is no longer produced. The company, *Risk*, only published it for 2 years which limits considerably the sample size and sampling period. Second, it provides data for only large companies included in the S&P 500. This will probably lead to a size bias in the results.

A couple of remarks are noteworthy here. First, when discriminating between the hedgers and non-hedgers groups, attention should be given to the ex-ante exposure of the firms. Only firms with exposure to risk that decide to hedge (or not to hedge) should be included in the sample. This control should eliminate noise in the results because it excludes from the analysis firms that might have the

[4] These databases were provided by Swaps Monitor Publications. The database of users was supplied as excel files. The Handbook of users contained the same information but was published as a book.
[5] We are very grateful to Betty Simkins for information concerning this datasource.

incentive to hedge but do not do it since they have no ex-ante exposure. Géczy, Minton and Schrand (1997) control for FX exposure by considering in their sample only firms that report pre-tax foreign income, foreign sales, foreign denominated debt or non-zero foreign tax expense. Graham and Rogers (2002) and Rogers (2002) also control for ex-ante exposure to FX and IR risks by using similar variables. Second, when identifying hedgers, one should make sure that the firms included in the "hedgers" group are actually reducing their risk and not speculating. This could be achieved by reading the documents where the keyword is found and make sure that the firm mentions that it is using the derivatives in order to hedge its exposure and not for trading purposes. Fortunately, SFAS 119 requires companies to disclose such information which should facilitate this task (this requirement applies however only for fiscal years ending after December 1995). Of course, the check is harder when hedgers are identified through a survey because managers might be reluctant to admit that they employ derivatives to speculate rather than reduce the firm's risk.

II. How to measure corporate hedging?

Providing an adequate measure for corporate hedging is an essential ingredient in a successful test of risk management theories. Several alternatives were proposed in the literature but four of them are the most popular: the dummy variable indicating derivatives usage (discrete measure), the gross notional value of derivatives contracts, the net notional value of derivatives contracts and finally the delta percentage (continuous measures). As Table II shows, it is common in this literature to use more than one measure of corporate hedging to conduct the tests. Indeed, almost 30% of the papers reviewed use more than a single variable to measure the extent of risk management in the firm.

(Insert Table II here)

A. Discrete measures of corporate hedging

The most common approach to measure corporate hedging consists in a dummy variable indicating whether the firm uses derivatives. Fourteen of the papers reviewed between 1985 and 2005 have recourse to this variable: eight papers use it alone, and six papers use it in combination with other measure(s). Several versions of the dummy variable were introduced in previous studies. For example, Nance, Smith and Smithson (1993), Fok, Carroll and Chiou (1997) and Jalilvand (1999) define derivatives usage as the holding of any type of derivatives; Géczy, Minton and Schrand (1997) define derivatives users as firms employing FX derivatives and Whidbee and Wohar (1999) restrict derivatives usage to FX or IR derivatives.

A dummy variable is a very appealing measure for corporate risk management activities because it is very simple to construct, but it has two major limits. First, it does not provide quantitative information about the hedging level in the firm. Consequently, a firm hedging 5% of its exposure will make up the population of hedgers just the same as a firm that fully hedges. This should make the distinction between hedgers and non hedgers more difficult since a firm that hedges 5% of its exposure is more likely to have characteristics similar to a non-hedger than to a firm that is practicing full hedging [Judge, 2003]. Second, the dummy variable approach supposes that derivatives usage is a synonym of risk management which is not always true. Firms can manage their risks not only with derivatives, but also through operational and financing transactions. For example a firm can decide to reduce its FX risk by reducing the number of factories it holds abroad and replacing them by local facilities. A natural consequence of equating hedging with derivatives usage is to underestimate the number of non-hedgers because every firm that is managing its risks by any tool other than derivatives is identified as a non-hedger. According to Judge (2003), one solution to alleviate this problem is to introduce variables that indicate the existence of other risk management strategies but this way of doing still does not solve the problem for naturally hedged companies because there will be no indication of hedging activities.

Another limit that makes the dummy variable approach controversial is that the latter captures information only about the decision to hedge. It is not guaranteed that arguments explaining such decision are also significant explanations of the hedging extent. As mentioned earlier, Haushalter (2000), Allayannis and Ofek (2001) and Mardsen and Prevost (2005), among others, showed substantial differences between the determinants of the decision to hedge and determinants of the hedge ratio.

Furthermore, recall that derivatives usage is not always a synonym of risk reduction. In some cases, managers hold positions on derivatives, under the guise of hedging, in order to outperform the market in case their expectations are realized. In a similar situation derivatives usage could increase the firm's risk instead of reducing it.

B. Continuous measures of corporate hedging

More recent papers propose the gross notional value of derivatives contract held for non-trading purposes (scaled by the firm's size) as a measure for corporate hedging. Interestingly, Table II shows that this variable is considered alone in only three of the ten papers that used it. Earlier papers combine it with the fair value of the derivatives contracts held [Berkman and Bradbury, 1996; Howton and

Perfect, 1998] while more recent papers combine it with a dummy variable indicating derivatives usage [Allayannis and Ofek, 2001; Dolde and Mishra, 2002; Nguyen and Faff, 2003; Lel, 2004].

The gross notional value has several advantages over the dummy variable. Most importantly, it provides quantitative information about the level of risk management. This makes tests of hypotheses on the determinants of the amount of corporate hedging possible. However, the gross notional value might overestimate the risk management activities in the firm when the latter holds offsetting contracts. Indeed, to calculate this variable we sum up the different notional values of derivatives contracts held by the firm regardless of the position taken (short or long). Allayannis and Ofek (2001) point out an additional problem in the gross notional value when measuring corporate hedging of the FX risk. They highlight that firms do not report derivatives holdings by individual currency and seem first to net positions on these currencies before aggregating them. Such aggregation will introduce a measurement error in the data.

In order to avoid the problems associated with the gross notional value, Graham and Rogers (2002) and Rogers (2002) propose the absolute value of the net position held by the firm on derivative contracts for non-trading purposes (scaled by the firm's size) as a measure for corporate hedging. This variable should provide a cleaner measure of the risk management activities compared to the dummy and the gross notional value variables. However, Judge (2003) argue that, unless the firm size is a good proxy of the firm's exposure to the risk studied, it is not clear whether this variable provides an appropriate measure of the extent of corporate hedging undertaken (this argument is true also for the gross notional value variable when it is scaled by a measure of the firm's size). Additionally, the net notional value of derivatives does not distinguish between the different derivatives contracts. This may lead us to conclude that a firm having a $90 millions long position in options and a $50 millions short position in futures-a net position of $40 millions- is having the same risk management strategy than a firm having a long position of $40 millions only in the forward markets. A risk management strategy implies decisions concerning both the amount of risk to hedge and the instruments employed to hedge, and the net position gives no information about the second point. It is worth noting that the dummy variable and the gross notional value also suffer from this limit. Furthermore, the two papers that used the net notional value to measure corporate hedging [Rogers, 2002; Graham and Rogers, 2002] sum up net values from different risks (IR risk and FX risk). By doing so, they suppose that the risk management of these two risks are affected by the same factors which has been shown not to be the case [Mardsen and Prevost, 2005; Haushalter, 2000; Allayannis and Ofek, 2001]. Finally, despite the fact that they provide quantitative information about the level of risk management in the firm, the gross and net

notional value variables consider only transactions on derivatives when evaluating the extent of corporate hedging. This will lead to the same problems discussed earlier for the dummy variable when equating risk management with derivatives usage.

The fourth approach proposed in the literature to measure risk management activities is the delta percentage. The delta percentage is defined as the delta of the risk management portfolio held by the firm divided by its expected production and provides a continuous measure of corporate hedging. The delta percentage was first introduced by Tufano (1996) and more recently used by Dionne and Garand (2003) and Dionne and Triki (2004, 2005)[6]. Unlike the previously mentioned variables, the delta percentage intervenes in its calculation information relative both to the level of hedging and to the instruments selected to hedge. More importantly, it recognizes that risk can be managed not only through derivatives transactions but also through financing operations.

Unfortunately the delta percentage is not perfect and presents some problems that limit its attraction. First, its calculation requires very detailed data concerning the derivatives transactions and financing operations realized by the firm. These details are hardly obtainable from publicly available sources. Thus, its usage remains limited to the gold mining industry for which such detailed data is available. Consequently, until now, the delta percentage provided industry specific results. As pointed out by Géczy, Minton and Schrand (1997, p 1325) "*by construction, industry specific studies diminish cross-sectional variation in the firm's exposures, but they do so at the expense of cross-sectional variation in the potential incentives to hedge*". Furthermore, even for the gold mining industry where Ted Reeve compiled the data required for the calculation of the delta percentage, the sampling period must end in 1999 because Mr. Reeve stopped conducting his surveys after this date.

An additional limit of the delta percentage concerns the scaling variable in its calculation, i.e. the expected production of gold. This variable is appropriate for scaling only if the production level in a given period is very similar to the firm's gold sales because, technically, it is the amount of gold sold and not the amount produced that is exposed to price fluctuations [Judge, 2003]. Finally, recall that for a given date, the delta percentage is calculated without any consideration for the hedging operations happening beyond a three years window because projected production after this point is generally not available. Such practice should underestimate the level of risk management activities in the firm.

[6] Brown, Crabb and Haushalter (2003) use the changes in the value of the delta percentage as a dependent variable because they are interested in explaining variation in the hedging ratio.

Few other measures for corporate hedging were proposed in the literature but their popularity remains limited. In addition to the gross notional value, Berkman and Bradbury (1996), Howton and Perfect (1998) and Mardsen and Prevost (2005) use, for example, the fair value of the derivatives contracts held by the firm scaled by its market value[7]. The fair value is defined as the absolute value of the net gain or loss on all the derivatives contracts held by the firm. This measure is potentially noisy because it is affected by the movement of the risk variable being hedged and the time elapsed since the inception of the contracts used to hedge. Indeed, if the time elapsed and/or the movement of the risk variable being hedge are insignificant, the fair value of the contract could be small even if the firm hedges extensively its risks. Furthermore, the fair value suffers from the problems arising when equating risk management with derivatives usage discussed earlier.

Overall, each of the four measures mentioned in this section has its advantages but also its own limit which means that none of them is perfect. Usually, it is the data availability that conditions the usage of one or the other of these variables to measure corporate hedging.

III. What factors affect corporate hedging and how to measure them?

Several explanations were proposed as motives for corporate hedging. Some of them are backed by theoretical models while the introduction of others is encouraged simply by common sense. The most cited arguments justifying corporate hedging are the reduction of the financial distress costs, the tax liability, the underinvestment costs as well as the satisfaction of managerial risk aversion. Recently, explanations based on corporate governance and macro economic characteristics were introduced. In the following we will describe the most popular arguments included in tests of risk management theories as well as the variables proxying them. Particularly, we will explain the advantages and drawbacks related to the usage of these proxies.

A. Taxes

The tax argument, first introduced by Smith and Stulz (1985), suggests that if the firm faces a convex tax function, because hedging reduces the variability of the taxable income, by Jensen's inequality the firm will end up with a lower tax liability. Consequently, for a convex tax function, as long as hedging costs do not exceed its benefits, hedging increases after tax firm value. This prediction was confirmed

[7] Interestingly, both the Mardsen and Prevost (2005) and Berkman and Bradbury (1996) papers use data relative to New Zealand companies. We are inclined to think that either information about fair value is easily obtainable in this country or that fair values are a standard approach for researchers in New Zealand.

by results reported among others in Nance, Smith and Smithson (1993). Over the twenty papers that controlled for the tax argument, eleven papers include one variable, six papers include two variables, two papers include three variables and one paper includes four variables as proxy for the tax incentive to hedge.

As Table III shows, the most popular measure of the tax function convexity is the amount of the tax loss carryforwards (TLCF hereafter) [Nance, Smith and Smithson, 1993; Tufano, 1996; Fok, Carroll and Chiou, 1997; Knop, Nam and Thornton, 2002….etc] or a dummy variable indicating the presence of such item in the firm's balance sheet [Berkman and Bradbury, 1996; Mian, 1996; Mardsen and Prevost, 2005…etc].

These two variables are very easy to construct and need simple inputs available in widely used databases like COMPUSTAT. Also, it is true that these tax shields extend the convex portion of the tax function [Graham and Smith, 1999]. However, variables based on TLCF suppose implicitly that firms with such tax shields face a convex tax function which is not always true. Graham and Rogers (2002) find that TLCF are uncorrelated with the tax function convexity. They conjecture that variables based on this tax shields are probably better proxies for a low marginal tax rate and/or financial distress costs than for the tax convexity. Additionally, Graham and Smith (1999) argue that these proxies are too simple to capture incentives resulting from the tax convexity and may even lead to erroneous conclusions. Indeed, existing net operating losses or any other tax provisions will provide a tax disincentive to hedge for firms expecting to loose money because hedging reduces the "*right tail*" outcomes and consequently the chance that the firm uses these existing losses.

A second measure that is commonly proposed for the tax function convexity is a dummy variable indicating whether the firm's pre tax income is expected to be in the progressive region of the tax code[8]. Beware that this variable could proxy other aspects of the firm. Indeed, firms whose income is

[8] The US tax code imposes in general for each taxable year on the taxable income of every corporation a tax amount equals to:
(A) 15 percent of so much of the taxable income as does not exceed $50K,
(B) 25 percent of so much of the taxable income as exceeds $50K but does not exceed $75K,
(C) 34 percent of so much of the taxable income as exceeds $75K but does not exceed $10M,
(D) 35 percent of so much of the taxable income as exceeds $10M. In the case of a corporation which has taxable income in excess of $100K for any taxable year, the amount of tax determined under the preceding sentence for such taxable year shall be increased by the lesser of (i) 5 percent of such excess, or (ii) $11,750. In the case of a corporation which has taxable income in excess of $15M, the amount of the tax determined under the foregoing provisions of this paragraph shall be increased by an additional amount equal to the lesser of (i) 3 percent of such excess, or (ii) $100K. Under this tax code, the region with the most important progressive region concerns incomes between 0-100K$.

largely in the progressive region are usually more likely to suffer from financial distress and are also smaller. An additional weakness of this variable is that income is measured post hedging

Variables based on the investment tax credits (ITC hereafter) or foreign investment tax credits (FTC hereafter) could also serve as measures for the tax function convexity. Graham and Smith (1999) show however that these two provisions have only a modest effect on the convexity of the tax function. Commonly, the amounts of these tax shields [Nance, Smith and Smithson, 1993; Fok, Carroll and Chiou, 1997; Bartram et al., 2004] or a dummy variable indicating their presence [Mian, 1996; Bartram et al., 2004] are used. Variables based on the ITC are controversial because they may proxy for some aspects of the firm's investment opportunities. Indeed, only certain categories of assets give rise to ITC. Also, instead of measuring the tax function convexity, variables based on FTC can proxy the presence of foreign operations and, consequently, exposure to currency risk.

It is noteworthy that the three previously mentioned variables are measures of the tax function convexity, thus providing information about the existence of a tax advantage but not about the level of this advantage. Graham and Smith (1999) propose a simulation procedure that quantifies the tax savings resulting from a decrease in the volatility of the taxable income when the firm uses risk management. Their methodology provides a precise measure of the tax incentive to hedge. Interestingly, the calculation of their variable allows the introduction of the different provisions in the tax code. The simulation approach presents however two minor limits. First, Graham and Smith (1999) treat all firms listed in COMPUSTAT identically by applying the American legislation and tax code to their whole sample. Second, the simulations are repeated 50 times to generate this variable which could be insufficient when dealing with simulations. Dionne and Triki (2004) remedy to these limits by applying for each firm in their sample the tax code of its home country and by repeating the simulations 1000 times[9].

(Insert Table III here)

B. Financial distress costs

If financial distress is costly, firms are better off with hedging activities because they reduce its probability. According to Smith and Stulz (1985), financial distress costs provide a possible

[9] Dionne and Garand (2003) use the model that Graham and Smith (1999) propose to explain the convexity-based tax savings from hedging in order to predict the values of this variable for their sample. Considering that the adjusted R^2

explanation of why firms hedge. Assuming a fixed investment policy, they argue that hedging can decrease the present value of financial distress costs even if hedging is costly. Consequently, hedging increases shareholders' wealth because it decreases the expected value of direct bankruptcy costs and the loss of debt tax shield. Twenty four papers among the thirty two reviewed control for the financial distress costs motive: six papers use one proxy, twelve papers use two proxies, five papers use three proxies and one paper uses five proxies to control for this argument.

Leverage is the most popular measure for financial distress costs[10]. As table IV shows, it is included as an explanatory variable in all but one of the reviewed papers that control for this argument. Measuring the financial distress costs with leverage relies on the implicit assumption that firms with important gearing in their capital structure are more likely to face financial distress. Berkman and Bradbury (1996), Haushalter (2000), Gay and Nam (1998), Rogers (2002) and Graham and Rogers (2002) reported evidence suggesting a positive relation between leverage and corporate hedging while Nance, Smith and Smithson (1993), Géczy, Minton and Schrand (1997), Tufano (1996) and Allayannis and Ofek (2001) report an insignificant coefficient for this variable. Dionne and Garand (2003) propose a combination of leverage and liquidity to proxy financial distress costs. Their variable is set equal to one for firms with a debt and a quick ratio, respectively, above and below the industry's median. Firms with important gearing in their capital structure and low liquidity ratios are more likely to face high distress costs.

A major concern with leverage is that it ignores possible variations in the exogenous bankruptcy costs across firms and fails to address the possibility that these costs might affect the firm's gearing. Indeed, firms facing low exogenous financial distress costs can choose a high leverage. Despite having an important gearing (synonym of a greater probability of financial distress), these firms have few incentive to hedge. Additionally, several researchers argue that leverage should not be modelized as an exogenous variable when testing corporate hedging theories. If financial distress is costly and debt presence in the capital structure allows fiscal advantages or a reduction in the agency costs, risk management can increase the debt capacity because it reduces the probability of financial distress. The idea that risk management increases the debt capacity is developed in Stulz (1996), Leland (1998) and Graham and Rogers (2002). Modelizing the risk management and the debt decisions as simultaneous

reported for the Graham and Smith (1999) model is 8.2%, one would have some reserves concerning the capacity of the Dionne and Garand (2003) variable to capture properly the value of the tax savings from hedging.

[10] Whidbee and Wohar (1999) use the ratio of the firm's market value of equity to its total value. This is an inverse measure of leverage.

could complicate the model and the estimation procedure. For example Dionne and Triki (2004) had to develop a sophisticated method that relies on Gauss-Hermite quadrature rules in order to estimate their system of simultaneous equations.

Variables based on the interests' payments could also serve as measures for the financial distress costs. Commonly, the interest coverage ratio is included to control for these costs [Gay and Nam, 1998; Nance, Smith and Smithson, 1993; Berkman and Bradbury, 1996…etc]. The idea is that firms with a low interest coverage ratio are less likely to honour the promised payments on their debt because they do not generate enough cash from their operations. It is true that firms that do not generate enough cash from their operations have a greater probability to be financially constrained but this does not mean that they are automatically in distress. It is possible that these firms generate enough cash from their financing operations or have important cash buffers that allow them to meet their outstanding financial responsibilities. Consequently, a low interest coverage ratio is not always an indication of financial distress. Tufano (1996) and Haushalter (2000) use the operating costs of production to measure financial distress costs on the ground that firms with low operational costs are less likely to suffer from financial distress. This is also a measure of financial distress that is based on the operational efficiency of the firm.

Several papers propose the credit rating on the firm's long term debt as a measure for financial distress costs [Jalilvand, 1999; Géczy, Minton and Schrand, 1997]. Credit ratings are the result of qualitative and quantitative analysis focusing on the credit quality of the firm and its underlying financial commitments. They consequently provide a good indication concerning the probability of financial distress. Unfortunately, this variable probably introduces a size bias in the results because larger firms are more likely to have their debt rated. Furthermore, credit ratings are ordinal measures that provide less information about financial distress than continuous variables.

Finally, Brown, Crabb and Haushalter (2003) use changes in the ratios included in the calculation of the Altman Z-score to proxy changes in the probability of financial distress. We think that the Altman Z-score is an excellent alternative to capture information about the firm's financial distress probability. The advantage of such proxy is that it summarizes information available in different ratios which gives it a multivariate aspect. Of course, this measure is not perfect since we have no guarantee that the estimated equation contains the relevant ratios and coefficients to measure the financial distress in the sample considered.

Roughly speaking, the different variables above mentioned provide mainly information about the probability of financial distress rather than the costs associated with such problem. In order to tackle this issue, Graham and Rogers (2002) combine leverage with the firm's market to book ratio. They multiply both variables in order to capture information both about the probability of financial distress (captured by leverage) and the costs of distress (captured by the market to book ratio). We think it is important to develop variables in this spirit with a special attention to measures of distress costs.

(Insert Table IV here)

C. Underinvestment costs

The underinvestment problem describes situations where shareholders forego positive net present value projects because the gains accrue mainly to bondholders [Myers, 1977]. Firms with important investment opportunities who are financially constrained suffer the most from this problem. Hedging can alleviate the underinvestment issue by increasing the number of states in which shareholders are residual owners. This could be achieved by shifting cash from states in which cash flows are sufficient to face the firm's financial commitments to states where cash flows are insufficient to meet the firm's obligations. Furthermore, Froot, Scharfstein and Stein (1993) (FSS hereafter) show that, when the cost of external financing is more important than the cost of internal financing, hedging can mitigate the underinvestment problem because it ensures the availability of more internally generated funds that could be used to undertake the firm's investment opportunities. Morellec and Smith (2002) and Lin and Smith (2003) also establish a positive relation between hedging and the firm's investment opportunities when they consider simultaneously the financing, investment and risk management decisions. Commonly, papers include indicators of the firm's investment opportunities to control for this argument because the underinvestment problem affects more severely firms with an important investment set. Over the twenty five papers that controlled for this argument, nine use one proxy, eleven use two proxies, four use three proxies and one uses five proxies for underinvestment costs.

As table V shows, the most popular measure for the firm's investment opportunities is the book to market [Géczy, Minton and Schrand, 1997; Gay and Nam, 1998; Graham and Rogers, 2002; Lel, 2004…etc] or its inverse (the market to book) [Mian, 1996; Jalilvand, 1999; Allayannis and Ofek, 2001…etc]. In the papers we reviewed, this variable is rarely included alone in the tests. The rationale for using the market to book (or book to market) ratio is that the observed market value of the firm represents an assessment of the value of its assets in place and the value of its investment opportunities. When scaled by the value of the assets in place (which give us the market to book ratio), this variable

should provide a clear idea about the value of the firm's investment opportunities. However, Lin and Smith (2003) conjecture that since different firms have different structures of assets in place, a high market to book (low book to market) is not automatically an indication of more valuable investment opportunities.

The second most popular measure for the firm's investment opportunities, in the papers reviewed, is the amount of research and development expenses (R&D hereafter) scaled by the firm's size [Nance, Smith and Smithson, 1993; Fok, Carroll and Chiou, 1997; Gay and Nam, 1998; Knop, Nam and Thornton, 2002, etc…]. This variable is used on the grounds that R&D expenditures provide a reasonable indicator of future projects development. Empirically, Nance, Smith and Smithson (1993), Gay and Nam (1998), Graham and Rogers (2002) report a positive and significant coefficient for this variable while Howton and Perfect (1998) find an insignificant one. In the same spirit, Tufano (1996), Dionne and Garand (2003), and Dionne and Triki (2004) use the exploration and acquisition expenditures while Haushalter (2000) uses the investment expenditures to measure the firm's investment opportunities. These variables are included because gold mining (oil and gas) companies usually expend either internally by prospecting new mines (pits) or externally through acquisitions. Given the nature of their samples, their variables are more appropriate than the R&D expenditures.

FSS (1993) argue that R&D expenditures could also proxy for the extent of information asymmetry about the firm's project quality or the financial constraints facing the firm. Indeed, firms with few intangible assets and large amount of R&D expenditures usually have harder time to get external financing because they have no guarantees to offer in order to back up their contractual engagements. Moreover, Gay and Nam (1998) conjecture that the relation between R&D expenses and hedging might be driven by agency costs. Indeed, bad managers could hide their true quality by devoting more money to R&D or by mimicking the risk management strategies of good quality managers. In this case they will be attracted by hedging in order to mask their real quality and the quality of their projects. Furthermore, the fact that the disclosure of R&D expenditures is not mandatory could lead to a sample selection bias because firms that spend large amounts in R&D activities are more likely to disclose such information.

Several papers include liquidity measures to proxy for the firm's investment opportunities. Liquidity-based variables rest on the assumption that firms are more likely to forego positive net present value projects and thus suffer from underinvestment when their cash holdings are low. Jalilvand (1999) and Allayanis and Ofek (2001) use the dividend yield on the ground that firms could pile up more liquidity

by cutting their dividend payments, Borokhovich et al. (2004) use the quick ratio while Nguyen and Faff (2003) use both the current ratio and the ratio of cash and cash equivalents to the firm's size. Unfortunately, a negative coefficient reported for these liquidity measures could have another explanation than being an indication of an underinvestment problem. Indeed, firms may simply reduce their hedging activities through derivatives because they prefer to adopt a retention strategy. In this case, the hedge ratio will be negatively associated to the firm's liquidity measure.

Rajgopal and Shevlin (2002) propose an interesting approach to control for the firm's investment opportunities set. They use factor analysis to construct what they call the "investment opportunity set score" (IOS). Their variable combines information about the firm's market to book and exploration costs. We think it is interesting to develop new variables in this spirit because they combine information about different aspects of the firm's investment opportunities and are less likely to suffer from measurement errors.

It is worth noting that the FSS (1993) model does not suggest that it is the existence of growth opportunities that is a determinant of corporate hedging but rather the risk of not undertaking them because of the high cost of external financing. It follows that a test of risk management determinants should include not only proxies for the firm's investment opportunities but also variables indicating its capacity to undertake them. Different approaches were proposed in the literature to correct for this argument. For example, Géczy, Minton and Schrand (1997) multiply their measure of the firm's investment opportunities (market to book) by a measure of the external cost of financing (leverage). This variable was subsequently used in Lel (2004) and Bartram et al. (2004). Interestingly, Graham and Rogers (2002) use this variable to measure the financial distress costs where the leverage proxies the probability of financial distress and the market to book proxies the distress costs. This shows clearly that one should be careful when interpreting results drawn from this variable. Gay and Nam (1998) control for the FSS (1993) argument by including a dummy variable that equals one for firms reporting simultaneously a low level of cash and a high level of growth opportunities, zero otherwise. Haushalter (2000) includes a dummy variable equals to one if the firm's debt ratio is above the sample median and its current ratio ranks below the sample median (zero otherwise) as a proxy for financial constraint. Finally, Howton and Perfect (1998) and Nguyen and Faff (2003) control partially for the FSS argument by including variables that approximate only the capacity of the firm to undertake the investments. Howton and Perfect (1998) use the ratio of cash flow to total assets while Nguyen and Faff (2003) use a liquidity ratio and the current ratio. Overall, despite differences in the methodologies, the reported evidence in these papers provides support for the FSS (1993) argument.

(Insert Table V here)

D. Managerial risk aversion

Managers are usually less diversified than regular shareholders because they have their human capital, present and future compensations tied to the firm's value. Consequently, they will require additional compensation if they feel exposed to a high level of risk through the firm. Hence, managerial risk aversion provides an incentive for corporate hedging because risk management could lower equilibrium managerial compensation.

According to Smith and Stulz (1985), managers will hedge less as long as their expected utility is a convex function of the firm's value, even though their expected utility is a concave function of their personal wealth. Therefore, we expect managers with important options holdings to hedge less because options create a convex relation between the managers' utility and the firm's value. Tufano (1996), Rajgopal and Shelvin (2002) and Rogers (2002), among others, provide support for this hypothesis.

However, in a more recent paper, Carpenter (2000) shows that options compensation does not automatically lead to more risk seeking. According to her model, stock options create two opposing effects on managerial wealth. First, as the volatility of the firm stock returns increases, the payoffs from options become more important. This effect should, *ceteris paribus*, incite managers to hedge less. Second, as the stock price decreases, the payoffs from options become less important. This effect should incite risk adverse managers to increase their hedging in order to avoid a drop in the share price. Interestingly, Carpenter (2000) shows that managers who are paid with stock options could hedge more when the second effect prevails. The hypotheses drawn from her model were confirmed by results reported in Knopf, Nam and Thornton (2002), Géczy, Minton and Schrand (1997) and, Gay and Nam (1998).

Smith and Stulz (1985) also show that compensation packages that lead to a concave function between the managers' expected utility and the firm's value should encourage managers to hedge more. Accordingly, managers holding a significant fraction of the firm's shares should engage more actively in risk management.

Commonly, variables proxying separately for incentives from the stock compensation and the options compensation are included in the tests. As table VI shows, managerial risk aversion is less popular than the tax, financial distress and underinvestment costs explanations. Only seventeen of the reviewed papers controlled for this argument: eleven papers control both for incentives from stock and options

compensations, three papers control only for incentives from the stock compensation and three papers control only for incentives from options compensation. In the following, we will first discuss traditional variables proposed in the literature to control for these arguments then we will discuss a new approach based on the option pricing theory.

D.1. Incentives from stock compensation

Ideally, one should construct a variable that measures the proportion of the total manager's wealth invested in the firm's common equity to control for incentives related to stock compensation. Unfortunately, information about the managers' total wealth is impossible to get unless you work for the IRS. With this problem in mind, several alternatives measures were proposed in the literature.

The value of the common shares held by the firm's directors and officers [Dionne and Triki, 2004] or a logarithm specification of this variable [Tufano, 1996; Géczy, Minton and Schrand, 1997; Gay and Nam, 1998; Haushalter, 2000] are the most common proxies for incentives related to stock compensation. The major concern with these variables is that they suppose the total managerial wealth to be constant across managers in all firms and that the latter is not affected by the size of the management team. This assumption is not true. A reported positive relation between stock ownership and corporate hedging could be influenced by the size of the management team (larger teams are more likely to carry important stock holdings). In this case, the observed relation will be a statistical artefact of firm size being misspecified [Tufano, 1996]. Knop, Nam and Thornton (2002) and Rogers (2002) restrict their attention to the CEO shareholding on the ground that the latter has the ultimate power in an important decision such as corporate hedging. Their approach eliminates the bias of the management team size. However, if the risk management is a group rather than an individual decision, the number of common shares held by the CEO will not capture adequately the incentives generated from stock compensation. This will lead to a misspecified model.

Table VI shows that the fraction of common shares held by insiders could also be used to control for incentives from the manager's stock compensation. This variable provides a cleaner proxy than the number of shares because it measures the importance of managerial shareholding in the firm and therefore the degree of managerial diversification. Note that the definition of insiders varies across papers: Jalilvand (1999) for example considers the top five officers in the firm; Berkman and Bradbury (1996) consider the directors group while Nguyen and Faff (2003) and Mardsen and Prevost (2005) extend their analysis to all the directors and officers in the firm. Like the number of common shares, this variable suffers from the size of the management team bias because larger teams are more likely to

hold an important fraction of the firm's outstanding shares (this limit does not apply when the focus is on the CEO shareholding like in the Allayannis and Ofek (2001) case). Furthermore, recall that the fraction of common shares held by insiders is a common measure of the extent to which managers and shareholders' interests are aligned. Consequently, it may measure the intensity of agency problems between managers and shareholders rather than managerial risk aversion.

D.2. Incentives from options compensation

To control for incentives related to options compensation, several papers use the number of options held by insiders [Tufano, 1996; Gay and Nam, 1998; Haushalter, 2000; Dionne and Triki, 2004]. Once again, the results will suffer from the size of the management team bias (except for the case where only the CEO is considered). In order to correct for this limit, Haushalter (2000) uses the number of options held per director and officer and the number of options held per officer. Note that these variables are very sensitive to the definition of the insider group considered.

A major concern with the number of options held by insiders (or a modified version of this variable) is that it treats equally the risk taking incentives generated from the different options held. It is important to remember that the sensitivity of the manager's wealth to changes in the risk of the firm's equity is more important when the options held are deep in the money compared to cases where the options are out of the money. Accordingly, the number of options provides a noisy measure of the incentive generated by options because it ignores the characteristics of the options held. Also, Knop, Nam and Thornton (2002) argue that variables based on the number of options provide crude approximations of the incentive resulting from options compensation because they do not consider the two opposing effects that result from this form of compensation.

Nguyen and Faff (2003) and Allayannis and Ofek (2001) consider a scaled version of this variable. The scaling denominator in their case is the total number of the firm's shares outstanding. An important limit in the scaled version is that it supposes implicitly that each option held is equivalent to holding a share of the firm. This assumption is not always true. Even if the options are exercisable, it is possible that it is not financially interesting to exploit them. In this case, the variable used in the test will be hardly interpretable.

Table VI shows that the value of the options held by the CEO [Haushalter, 2000; Dionne and Triki, 2005] and the natural logarithm of the market value of shares obtainable upon the exercise of the options held by the CEO or the D&O [Géczy, Minton and Schrand, 1997; Knop, Nam and Thornton,

2002] are possible measures for the incentives generated by options-based compensation. These variables describe more adequately the financial incentive generated by options because they consider the payoffs from these instruments rather than their holding. One important detail to remember is that the market values of the options held are usually calculated with the dividend adjusted Black and Scholes model. This model is not appropriate when pricing executive stock options.

D.3. The Delta and Vega

A more adequate measure for the incentive generated by the manager's stock and options compensations are the Delta (sensitivity of the stock and option portfolio to changes in the price of the firm's stock) and Vega (sensitivity of the option portfolio to changes in the volatility of the firm's stock price). These measures are a direct application of the option pricing theory. Importantly, the Vega captures the convex effect stock options compensation has on the relation between the manager's wealth and the firm's value. Core and Guay (2002) developed a one-year approximation to calculate these Greeks. Their approach is attractive because (1) it is based on the incomplete information typically available in proxy statements and (2) it yields measures of sensitivities that are both unbiased and highly correlated (more than 95%) with the values obtained from a complete dataset concerning prior grants. The Delta and Vega measures were used by Knop, Nam and Thornton (2002), Graham and Rogers (2002) and, Rogers (2002)[11]. Overall, the empirical evidence reported in these papers supports the Smith and Stulz (1985) model predictions. Rogers (2002) states however that using the Delta and Vega in a ratio form (Vega to Delta) is more advantageous than examining them separately. By combining the two measures we won't need to specify separate models for risk taking and for value increasing incentives. Note that the economic interpretation of such ratio is also more intuitive because it measures the CEO risk-taking incentive per dollar of value-increasing incentives from option and stock holdings.

Using the Delta and Vega separately or on a ratio form is not without controversy. First, to calculate the Delta and Vega for a given fiscal year according to the Core and Guay (2002) approach, one needs detailed information about the value and the number of options already granted by the firm as well as the characteristics of the options granted during the considered year. This data is available in recent proxy statements but is hardly obtainable for earlier periods because companies were not obliged to disclose this kind of information. To comply with the requirements of the Core and Guay (2002) approach, one will have no other choice than dropping the earlier years in his sample. Such practice

could lead to a sampling bias in the results. Second, Core and Guay (2002) rely on the dividend-adjusted Black & Scholes model to estimate the sensitivities of the stock and option portfolios to stock return and stock return volatility. As mentioned earlier, this model is not appropriate for valuation when we deal with executive stock options (ESO). As stated in Rajgopal and Shevlin (2002), the partial derivatives used to calculate the sensitivities, likely overstates the real values of the ESO risk incentive (Vega) and the ESO wealth effect (Delta).

Some authors stress out the need to modelize incentives related to the manager's compensation as a choice variable when implementing a test of risk management determinants because risk also affects the compensation decision. For example, the managers may require more options-based compensation when the firm's risk is important. Rogers (2002) and Rajgopal and Shevlin (2002) model the CEO risk-taking incentives and hedging simultaneously. Their results show however that the negative association between the two variables is mainly driven by CEO risk-taking incentive providing a motive for managers to hedge less.

(Insert Table VI here)

E. Information Asymmetry

According to Stulz (1990), corporate hedging could reduce either the overinvestment or underinvestment costs resulting from the non-observability of managerial actions. The effectiveness of such policy in reducing these costs is in general, inversely related to the volatility of the cash flows generated by the firm. DeMarzo and Duffie (1991) also modelize information asymmetry as a determinant of corporate hedging. In their model, risk management reduces the noise in the firm's dividend stream which let shareholders better off. This is true even when hedging is costly. Breeden and Viswanathan (1998) consider a different source for information asymmetry that concerns the management competence. In their model, risk management reduces the noise in the learning process concerning the manager's capacities and corporate hedging is adopted mainly by high qualified managers to signal their superior abilities. Only seven papers from the thirty two reviewed controls for this argument.

Table VII shows that the percentage of the firm's shares held by institutions is the most popular measure of information asymmetry [Géczy, Minton and Schrand, 1997; Graham and Rogers, 2002;

[11] Rajgopal and Shevlin (2002) use only the Vega in their tests.

Rogers, 2002; Dionne and Triki, 2004, 2005]. This variable is included in regressions on the grounds that institutions have privileged information and the resources to monitor the firm's management. Also, institutions are themselves subject to strict disclosure requirements that oblige them to report periodically information about their investments. Accordingly, institutional shareholding should facilitate processing of information concerning the firm's operations and financials on the market. It is true that institutions have privileged information because firms used to provide important information to select securities analysts and/or institutional investors before disclosing it to the general public but the Regulation Fair Disclosure amended by the Securities and Exchange Commission (SEC) on 2000 prohibited such practice. Therefore, it is possible that institutional shareholding became a less effective proxy for information asymmetry after this period. It is important to notice that a negative coefficient reported for this variable could have another explanation than being an indication of a lower incentive to hedge in order to reduce information asymmetry costs. Indeed, institutions are usually well diversified and might find useless to manage the risk at the firm level. Consequently, they will encourage a reduction in the hedging ratio.

Another proposed measure in the literature for information asymmetry is the number of financial analysts following the firm [Géczy, Minton and Schrand, 1997]. When the firm is under greater public scrutiny, it should suffer less from information asymmetry. Consequently, information asymmetry should decrease with the number of analysts following its operations and so does the incentive to hedge. Beware here that a positive coefficient for this variable could be interpreted either as evidence supporting the reduction of information asymmetry cost motive or as indication that analysts choose to follow firms with fewer earnings surprises.

DaDalt, Gay and Nam (2002) conjecture that earnings related measures of information asymmetry are closer to the spirit of theoretical models that linked corporate hedging to information asymmetry. The first measure they consider is called "*the analysts forecast accuracy*" and is defined as the absolute value of the average earnings forecast error. To generate this variable, they first calculate the mean analyst earnings forecast. Next, they substract from it the actual earnings per share declared by the firm and they normalize this difference by the firm's stock price. Lin and Smith (2003) use a variant of this variable to proxy for information asymmetry. The second measure used in DaDalt, Gay and Nam (2002) is the dispersion in analysts' earnings forecast. According to them, analysts are unable to provide a precise and unanimous forecast of the firm's earnings when there is a lack of information about it. Variables based on the forecasting errors provide an interesting approach to measure

information asymmetry. The only concern when using them is that you never know whether the forecasting errors are caused by a higher level of information asymmetry or by other factors.

Haushalter (2000) conjectures that firms whose debt is rated have undergone more scrutiny and consequently suffer less from information asymmetry. He uses a dummy that equals one if the firm's debt is rated by S&P, zero otherwise as a measure for information asymmetry. The major issue with this variable is that it could introduce a sampling bias. Recall that financially healthy and / or large companies are more likely to undergo the rating procedure.

(Insert Table VII here)

F. Corporate governance characteristics

Risk management theory provides explanations for corporate hedging that are based on agency conflicts between managers, shareholders and debtholders. Accordingly, corporate governance characteristics should affect the risk management policy because corporate governance is the market solution to these agency problems. This recent literature primarily focuses on how the board independence and the ownership structure of the firm affect corporate hedging. As table VIII shows, only eight papers controlled for the firm's ownership structure and six papers controlled for the board's characteristics.

F.1. Ownership concentration

Firms characterized by a high ownership concentration are less likely to suffer from agency conflicts and, consequently, should hedge mainly in order to maximize their values. Also, large shareholders have the resources and incentives to exercise strict monitoring on the managers' activities thus reducing management incentive to hedge for their own interests. The most commonly used variable to control for the firm's ownership structure is the percentage of shares held by blockholders. Interestingly, the definition of blockholders varies a lot across papers. For example, Tufano (1996) considers as a blockholder a non managerial shareholder holding more than ten percent of the firm's shares and Mardsen and Prevost (2005) consider shareholders holding more than five percent of the firm's shares. Beware that managerial blockholding could serve also as a measure for the agency conflict intensity. Haushalter (2000) use the number of outside blockholders. We think that his variable is less appropriate than the one previously mentioned because a large number of blockholders is not always synonym of ownership concentration. For example, if the firm has one hundred blockholders holding each five

percent of the firm's shares, it will have an ownership structure that is less concentrated than a firm having one blockholder holding fifty percent of its shares.

Table VIII shows that the percentage of shares held by the firm's CEO [Whidbee and Wohar, 1999], insiders [Fok, Carroll and Chiou, 1997], outsiders [Whidbee and Wohar, 1999; Knop, Nam and Thornton, 2002] or institutions [Whidbee and Wohar, 1999; Fok, Carroll and Chiou, 1997] are possible measures for the firm's ownership concentration. Results obtained with these variables should be interpreted with caution because institutional shareholding could also proxy the intensity of information asymmetry [Géczy, Minton and Shrand, 1997; Rogers, 2002; Graham and Rogers, 2002] and the shareholdings of insiders/outsiders could also proxy for the agency conflict intensity. In a more recent paper, Lel (2004) uses dummy variables indicating the presence of an inside blockholders, outside blockholders, institutional blockholders as well as a variable measuring the wedge between the voting rights and the cash flow rights for the largest managerial blockholder. He argues that this last variable provides the cleanest measure of the severity of separation and control. His evidence suggests that the presence of an insider blockholders decreases the likelihood that the firm hedges while the presence of an outside blockholder or / and an institutional blockholder increases such probability.

The major concern with variables based on the number of common shares held by several entities is that they suppose that the firm has a single class of shares offering the same voting rights. After all, it is the voting rights and not the cash flows rights that are relevant when investigating control through shareholding. To overcome this limit, Borokhovich et al. (2004) use the fraction of total voting rights held respectively by insiders, blockholders and by banks to control for the firm's ownership structure. The originality of their approach lies not only on the fact that they use voting rights instead of cash flow rights but also on the fact they consider banking shareholding as a possible determinant of the hedging extent.

(Insert Table VIII here)

F.2. Board characteristics

Explanations based on the board characteristics were recently introduced in tests of corporate hedging theories and mainly focus on the independence of the board of directors. This new stream in the literature is encouraged by the increased fiduciary responsibilities assigned by the regulation to the board of directors as well as the increasing awareness that the monitoring of a manager determines the relation between his wealth and the firm's value and consequently its behaviour toward risk.

Particularly, the agency theory assigns an important monitoring role to outside directors because they are not influenced by the firm's management and may have the expertise that management lacks. Accordingly, board independence should play an important role in the firm's risk management activities.

Whidbee and Wohar (1999) were the first to link the decision to use derivatives to the board independence as measured by the proportion of outside directors sitting on it. Their evidence suggests that the managers' decision to hedge with derivatives is influenced by outside directors' membership in the board only at low levels of insiders' shareholdings. This is primarily caused by the fact that managers who own a small fraction of the firm's equity face a greater probability to be disciplined after a poor performance. This situation will usually incite them to seek more hedging. The fraction of outside directors sitting on the board was subsequently used by Dionne and Triki (2004) and Mardsen and Prevost (2005). Borokhovich et al include a modified version of this variable. They consider the difference between the number of outside and inside directors as a fraction of the board size. The evidence reported in Dionne and Triki (2004) and Mardsen and Prevost (2005) suggests a passive role for outside directors in the decision to hedge and the extent of hedging while the Borokhovich et al. (2004) findings suggest an active role for outside directors in the decision concerning the extent of hedging IR risk. The major difficulty when measuring the board independence consists in discriminating between outside and inside directors.

Table IX shows that other characteristics of the board of directors were also proposed as possible explanations for the decision to hedge. For example Borokhovich et al. (2004) include the board size and a dummy variable indicating the presence of a bank executive on the board. Their evidence suggests that these two characteristics have no effect on the firm's derivatives usage. More recently, Dionne and Triki (2005) extended the literature linking the board characteristics to the risk management policy by considering variables proxying not only the board independence but also its financial background. They explore multiple definitions for the board financial knowledge. Particularly, they examine the effect of the audit committee characteristics on the hedging extent. The variables included in Dionne and Triki (2005) mainly indicate whether the company complies with the requirements of the SEC and the NYSE in the matter of independence, financial knowledge and composition. Dionne and Triki (2005) report evidence suggesting that the financial education of the directors sitting on the board and on the audit committee is a relevant determinant of corporate hedging.

The literature linking the board characteristics to corporate hedging is still in its infancy. Until now, the work done in this topic mainly uses standard variables that were exploited in other literatures. We think that new variables specific to the risk management literature will be developed in the near future.

(Insert Table IX here)

G. Country-specific characteristics

The informational and institutional environments in which firms operate can affect considerably their risk management policies. The traditional approach in investigating the existence of a country effect consists in surveying derivatives usage among firms in distinct countries in order to detect different practices among them. Commonly, surveys compare US firms' practices to those of a set of firms in a different country. Bodnar and Gebhardt (1999) apply a matched-industry procedure to their samples of US and German firms, and conclude that German firms hedge more with derivatives than their US counterparts. Using a weighting methodology that corrects for differences in size and industry, Bodnar, De Jong and Macrae (2003) show that derivatives usage is more popular among Dutch firms when compared to US firms. This finding holds for all the size and industry classes they consider. They conjecture that this difference results from the greater exposure of Dutch firms to FX risk, the difference in orientation between the US and Dutch economies as well as the presence of a legal structure that is more protective of shareholders rights in the US[12]. The problem with the survey approach is that it permits only to detect differences in corporate hedging across countries but not to find the driving force behind these differences. Also, even if one wants to find explanations for such differences it is not possible to consider more than one explanation at a time. This is not appropriate considering the multivariate aspect of the risk management decision.

Lel (2004) and Bartram et al. (2004) propose, in multivariate frameworks, country-specific determinants for corporate hedging. To the best of our knowledge, these papers are the only ones providing macro economic explanations for the decision to hedge[13]. Lel (2004) considers the financial market development as well as the legal and economic characteristics of the country as possible

[12] Several additional papers surveyed the risk management practices outside the US [Berkman, Bradbury and Magan, 1997; Alkeback and Hagelin, 1999; De Ceuster, et al., 2000; Loderer and Pichler, 2000]. We decided to limit our discussion to surveys conducted by Bodnar and Gebhardt (1999) and Bodnar, De Jong and Macrae (2003) because they are the only ones that control for the similarity of the questions asked and for the firm's characteristics. Such control is important because it increases the likelihood that the observed results might be caused by institutional differences rather than firm characteristics. However, it is worth noting that all the previously mentioned papers reported evidence suggesting that firms outside the US have different risk management practices than their American counterparts.

[13] Lel (2004) considers FX derivatives usage while Bartram et al. (2004) consider all types of derivatives usage.

explanations for corporate hedging while Bartram et al. (2004) consider four explanations based on the access to derivatives market, the economic development of the country, the country risk and finally the legal environment.

It is obvious that the degree of financial market development in a country affects the firm's hedging policy because it conditions both its choice of instruments (the firms will hedge with the available instruments only) and its hedging cost. Particularly, firms in emerging economies are more likely to hedge because their countries have greater macro economic risk. Lel (2004) uses the country GDP per capita, the ratio of domestic credit provided by the banking sector to GDP, three dummy variables indicating respectively the presence of a derivatives exchange market, whether the country is classified as a bank-based economy and whether the country has a floating currency regime; and finally the percentage of banks assets that at least 50% foreign owned as proxies for the degree of financial market development. We think that variables based on macro economic indicators such as the GDP are more appropriate to measure economic development in the country rather than financial market development. Bartram et al. (2004) control for the development of the derivative market by including the average daily turnover net of inter-dealer double counting in the FX and IR derivatives market scaled by the country nominal GDP. This variable quantifies the size of the derivative market and is more appropriate than the dummy variable indicating the presence of such market already used in Lel (2004).

For the country legal and economic characteristics, Lel (2004) uses indices describing the shareholders and debtholders rights, a variable describing the degree of law and tradition in the country as well as variables that capture information about the integrity of the legal system and the importance of the market for corporate control. His results suggest that firms operating in a country characterized by a developed financial market, strong governance legislation are more likely to engage in corporate hedging. Bartram et al. (2004) use the GDP per capita and a dummy indicating OECD membership to proxy for economic development. They also include indices based on previous research to proxy for the country risk and legal environment. Their results suggest that the size of the derivatives market and the level of financial and economic risk in the country affect the decision to hedge. Their results do not show however that the legal environment matters.

Lel (2004) and Bartram et al. (2004) both consider risk management data for ADRs to conduct their tests. Studying ADRs is interesting in terms of common reporting. Unfortunately, such data might suffer from a selection bias because it is more likely that well performing international firms offer ADRs [Pagano, Roell and Zechner, 2002].

H. Substitutes to hedging with derivatives

Firms can and do use techniques other than derivatives to manage their risks. Three substitutes to hedging with derivatives were considered in the literature: risk management through financing activities, risk management through operating activities and finally the presence of liquidity buffers. Note that the two first alternatives are substitutes for hedging with derivatives while the third one is a substitute for hedging regardless of the instruments used to hedge. Over the nineteen papers that controlled for the existence of substitutes to hedging with derivatives: four papers use one variable, seven papers use two variables, four papers use three variables, three papers use four variables and one paper uses five variables to proxy for this argument

Petersen and Thiagarajan (2000), show that firms with a greater flexibility in their operating costs are less likely to hedge. Few papers control for risk management through operations mainly because it is very difficult to measure such activity [Fok, Carroll and Chiou, 1997; Tufano, 1996; Lel, 2004]. The standard approach in the literature, when controlling for risk management through operations, is to include a diversification measure of the firm's activities. The idea is that well diversified firms need in lower extent derivatives to hedge because they are less exposed to risk. Diversification is measured by different ways in the literature. Lel (2004), for example, uses a dummy variable equals one if the firm has at least one other business segment with a different SIC code, 0 otherwise[14] while Fok, Carroll and Chiou (1997) use a dummy indicating whether the firm is defined as a multinational. Tufano (1996) and Haushalter (2000) measure the firm's diversification with continuous variables. The former includes the percentage of the firm's assets outside the mining sector while the latter includes the fraction of total revenues generated from oil and gas production. These variables are certainly appropriate measures for diversification but do not provide information about the changes in the firm's operations aimed to reduce its risks. In the Tufano (1996) or Haushalter (2000) case, a more adequate measure would be the changes in the amount of gold (oil) produced given that firms usually adjust their production in order to reduce their exposure to CR.

Financing operations could also reduce the need for hedging with derivatives. Nance, Smith and Smithson (1993) were the first to discuss the usage of preferred stocks and convertible debt as substitutes to hedging with derivatives. Indeed, compared to regular debt, external financing in the form of preferred stocks or convertible debt reduces the probability of financial distress and

consequently the need for hedging with derivatives. Nance, Smith and Smithson (1993) include the book value of preferred shares and the book value of convertible debt (both scaled by the firm's size) to control for risk management through financing operations. Their variables became standard in the literature and were subsequently used by Gay and Nam (1998), Géczy, Minton and Schrand (1997), Fok, Carroll and Chiou (1997) and Howton and Perfect (1998)[15]. Jalilvand (1999) includes a dummy variable indicating the usage of convertible debt by the firm. His variable provides unfortunately less information about the importance of these financing operations than the Nance, Smith and Smithson (1993) variable.

Firms carrying important liquidity buffers are more likely to engage in retention strategies which should lower their demand for hedging with derivatives. Furthermore, financial slack decreases the probability of financial distress and consequently the incentive to hedge in order to reduce the costs associated with such problem. The literature has generally developed among two main lines when controlling for this substitute to hedging with derivatives. One strand has recourse to direct accounting measures of liquidity. The most popular measures considered in the literature are the current ratio [Nance, Smith and Smithson, 1993; Fok, Carroll and Chiou, 1997] and the quick ratio [Géczy, Minton and Schrand, 1997; Tufano, 1996; Rajgopal and Shevlin, 2002; Dionne and Triki, 2004…etc.]. Usually a negative coefficient for these variables is interpreted as being an indication that liquidity buffers are substitutes to hedging with derivatives. This interpretation ignores that some firms have higher demand for liquidity which may lead to a higher hedging level and liquidity ratio [Borokhovich et al., 2004].

The second strand in the literature focuses on the source behind the observed liquidity. It supposes that lower dividend payments could help the firm build liquidity cushions. Consequently, hedging will be negatively associated to the firm's dividend payments. The common approach consists in including the dividend yield [Nance, Smith and Smithson, 1993; Fok, Carroll and Chiou, 1997; Knopf, Nam and Thornton, 2002; Nguyen and Faff, 2003…etc.] or the dividend payout ratio in the regressions [Berkman and Bradbury, 1996; Géczy, Minton and Schrand, 1997; Jalilvand, 1999; Rajgopal and Shevlin, 2002]. Lel (2004) uses a modified version of the dividend yield. His variable is set equal to one if the firm's dividend yield is greater than the median value for the sample, 0 otherwise. It is worth noting that a negative coefficient for the dividend yield could have another interpretation than being an

[14] Fok, Carroll and Chiou (1997) use a measure of diversification as control for the firm's exposure. Their variables equals the number of two-digit SIC codes assigned to a company.
[15] Lel (2004) controls only for convertible debt usage while Knop, Nam and Thornton (2002) controls only for financing through preferred shares.

indication that hedging and liquidity are substitutes. Indeed, well established firms are more likely to pay high dividends and are also more likely to have low variance cash flows. Such firms will have less need for hedging and this will lead to a negative relation between their hedging ratio and dividend yield.

Papers that investigated the risk management determinants of the FX risk also consider the issuance of foreign denominated debt as a substitute to hedging with derivatives. Géczy, Minton and Schrand (1997) argue that such strategy might be cheaper than a series of short term forward contracts for example because it exposes the firm to a lower basis risk. Lel (2004) uses the foreign denominated debt ratio while Bartram et al. (2004) include a dummy indicating the presence of such debt in the firm's capital structure. Overall, the reported results in both papers suggest that foreign denominated debt is not a substitute for currency derivatives.

(Insert Table X here)

I. Exposure and variation

Firms with volatile cash flows or greater fraction of their revenues exposed to the risk considered should be more attracted by hedging activities. Among the papers reviewed, thirteen consider the firm's exposure as a rationale for corporate hedging.

Interestingly, the firm's exposure is included mainly in papers that focus on the FX risk. The most popular proxies for exposure to the FX risk are the foreign sales to total sales ratio [Géczy, Minton and Schrand, 1997; Allayannis and Ofek, 2001; Graham and Rogers, 2002; Lel, 2004] and the dummy variables indicating either the presence of foreign operations or foreign income[16] [Howton and Perfect, 1998; Jalilvand, 1999]. We think that variables indicating the presence of foreign income or foreign operations are less informative than the continuous ones previously mentioned. Table XI shows that the exchange rate volatility [Mardsen and Prevost, 2005], the foreign asset to total asset ratio [Géczy, Minton and Schrand, 1997], the total trade to total production ratio [Allayannis and Ofek, 2001] are also possible proxies for the firm's exposure to FX risk. Dolde and Mishra (2002) propose a more complex methodology to measure the firm's exposure to FX risk. Their variable is set equal to one for firms whose stock return sensitivities to major exchange rates are superior to the sample median, and their ratio of foreign income to total sales and volatility of the cumulative translation account are non

[16] Bartram et al. (2004) use a dummy variable that equals one if the firm reports foreign assets, income or sales, 0 otherwise.

null, 0 otherwise. This variable captures information about transaction, translation and operating exposure which makes the interpretation of its coefficient complicated. In this case, it is hard to know which exposure component is behind the observed result.

Table XI shows that control for exposure to IR risk could be achieved by including the interest rate volatility [Mardsen and Prevost, 2005] or the floating debt to total debt ratio [Graham and Rogers, 2002]. Note that the interest rate volatility is more appropriate to measure macro economic exposure to IR rather than the firm specific exposure to this risk. Finally, Rajgopal and Shevlin (2002) control for exposure to oil and gas prices by including the ratio of sales from these commodities to total sales while Brown, Crabb and Haushalter (2003) include the change in the spot gold price and the change in the implied volatility of the gold futures contract to control for exposure to the gold price.

(Insert Table XI here)

J. Size

If hedging costs are inversely proportional to the firm size, smaller firms should have a higher hedging ratio because the reduction in financial distress costs is more important in their case. Also, according to the FSS (1993) model, firms facing expensive external financing are more likely to hedge. Since small firms usually suffer from information asymmetry and face higher transaction costs when searching external financing, they are more likely to hedge. However, if the hedging costs are fixed, larger firms should engage more actively in risk management because it corresponds to an expensive activity that smaller firms can not afford. Larger firms might also hedge in a greater extent because they have more complicated and geographically dispersed operations and consequently a greater need to hedge. Block and Gallagher (1986), Berkman and Bradbury (1996), Mian (1996), Nance, Smith and Smithson (1993), Géczy, Minton and Schrand (1997) and, Haushalter (2000) all report evidence suggesting a positive relation between hedging and size. Their results confirm the scale economies argument justifying hedging activities.

Table XII shows that the most popular measure of the firm's size is its market value [Nance, Smith and Smithson, 1993; Mian, 1996; Tufano, 1996; Haushalter, 2000], or its natural logarithm [Gay and Nam, 1998; Jalilvand, 1999; Whidbee and Wohar, 1999; Knop, Nam and Thornton, 2002; Mardsen and Prevost, 2005]. The definition of market value differs a lot across the papers. In second position comes

the book value of total assets or its natural logarithm [Fok, Carroll and Chiou, 1997; Brown, Crabb and Haushalter, 2003; Allayannis and Ofek, 2001; Rajgopal and Shevlin, 2002; Lin and Smith, 2003; Lel, 2004]. Notice that size could measure not only the scale economies argument, but also the firm's financial distress costs [Berkman and Bradbury, 1996], or the extent of information asymmetry [Rogers, 2002].

(Insert Table XII here)

IV. Conclusion and possible extensions

This paper has reviewed three important problems associated with the implementation of corporate hedging theories tests. We start with the first question pertaining to the different methodologies used in the literature to discriminate between hedgers and non-hedgers. We identify three different approaches to achieve this task. The first approach consists in surveying directly the companies. The second approach consists in searching the firm's public documents for keywords like "risk management", "hedging", "derivatives", "swaps", "options"…etc. Thanks to the mandatory disclosure requirements set by regulators recently, we expect this approach to become the standard way of doing in the literature. The third approach consists in using proprietary data. We describe two possible alternatives explored in the literature for this approach: data collected by professionals like financial analysts, brokers, bankers; and data available in paying databases like the database of users of derivatives, the handbook of users of off-balance sheet instruments and the corporate risk management handbook.

The second question we review concerns measures of corporate hedging. We discuss the four most popular measures proposed in the literature for corporate hedging: the dummy variable indicating derivatives usage, the gross notional value of derivatives contracts, the net notional value of derivatives contracts and finally the delta percentage. We describe for each measure the advantages and limits related to its usage. Notice, that the choice of one measure or another for corporate hedging is in a great extent conditioned by the data availability.

The third part of this paper reviews the different arguments justifying corporate hedging as well as the most popular variables used to proxy for them. Basically, there are five traditional arguments that keep coming in the papers: the reduction of the tax liability, the reduction of the financial distress costs, the reduction of the underinvestment costs, the size effect and finally managerial risk aversion. We also discuss other explanations for corporate hedging that are based on information asymmetry, corporate governance characteristics, country-specific characteristics, the firm's exposure to risk and finally the

existence of substitutes to hedging with derivatives. We show that multiple variables could be used to proxy for each of these arguments and describe the advantages and limits of these proxies. More importantly, we show that some of these proxies could measure more than one argument at a time. Accordingly, results from the tests should be interpreted with a lot of caution.

In summary, the review showed that an impressive amount of work has been done in the risk management literature but that there is still a lot of work to do in order to improve the quality of corporate hedging theories tests. We think that the need for cleaner proxies in this literature is more important than ever because richer datasets and new arguments are waiting to be explored.

We also think that tests of corporate hedging theories should focus on the following additional problems in the future: the determinants of integrated risk management strategies, the joint determination of the decision to hedge and the extent of hedging, and finally the determinants of instruments choice in a hedging strategy.

The first empirical question is motivated by the increasing popularity of integrated risk management and the growing debate claiming the necessity to adopt a portfolio approach when managing the firm's risks. According to Doherty (2000) such strategy is designed to support optimal investment and is more cost effective. We think that it is interesting to check whether the hedging of a portfolio of risks is affected by the same factors than the hedging of a single risk.

The necessity to examine jointly the decision to hedge and the extent of hedging is motivated by the fact that these two decisions are interdependent. Indeed, we usually observe the hedging ratio only if the firm decides to hedge. Therefore, it is important to incorporate this interdependence in the research design when testing corporate hedging theories.

Finally, since risk management implies both decisions on the extent of hedging and the instruments used to hedge, we should not limit our attention only to the first aspect of this policy. Thus, we think that future research should try to investigate not only the determinants of the hedging ratio or the decision to hedge but also why firms choose certain instruments and not others to hedge. This task is in a great extent facilitated by the availability of better quality data on corporate hedging.

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Table I: Methodologies used to identify hedgers

This table summarizes the different approaches used in the papers reviewed to identify hedgers in the population they consider

Authors Name	Year of Apparition / Publication	Country	How hedgers are identified
Block and Gallagher	1986	US	Survey
Nance, Smith and Smithson	1993	US	Survey
Berkman and Bradbury	1996	New Zealand	Keyword search
Mian	1996	US	Keyword search
Tufano	1996	US-Canada	Private data provided by Ted Reeve
Fok, Carroll and Chiou	1997	US	Handbook of users of off-balance sheet instruments
Géczy, Minton and Schrand	1997	US	Keyword search
Howton and Perfect	1998	US	Keyword search
Gay and Nam	1998	US	Database of users of derivatives
Jalilvand	1999	Canada	Survey
Haushalter	2000	US	Survey
Allayannis and Ofek	2001	US	Keyword search
Rajgopal and Shevlin	2002	US	Keyword search
Rogers	2002	US	Keyword search
DaDalt, Gay and Nam	2002	US	Database of users of derivatives
Knopf, Nam and Thornton	2002	US	Database of users of derivatives
Graham and Rogers	2002	US	Keyword search
Dolde and Mishra	2002	US	Keyword search
Bodnar, Jon and Macrae	2003	US-Netherlands	Survey
Nguyen and Faff	2003	Australia	Keyword search
Dionne and Garand	2003	US-Canada	Private data provided by Ted Reeve
Brown, Crabb and Haushalter	2003	Canada-US	Private data provided by Ted Reeve

Lin and Smith	2003	US	Database of users of derivatives
Borokhovich et al.	2004	US	Corporate Risk management Handbook
Dionne and Triki	2004	US-Canada	Private data provided by Ted Reeve
Bartram et al.	2004	48 countries	Keyword search
Lel	2004	34 countries	Keyword search
Mardsen and Prevost	2005	New Zealand	Keyword search
Dionne and Triki	2005	US-Canada	Private data provided by Ted Reeve

Table II: Summary of variables used to measure corporate hedging

This table summarizes the different measures of corporate hedging used in the papers reviewed. % stands for percentage, MV for market value, TA for the book value of total assets, All for all categories of risks, CR for commodity risk, FX for foreign exchange risk and, IR for interest rate risk.

Authors Name	Year of Apparition / Publication	Variable(s) used	Risk(s) considered
Nance, Smith and Smithson	1993	Dummy=1 if derivatives used	All
Tufano	1996	Average delta% over the year	CR (gold)
Mian	1996	Dummy=1 if derivatives used	All, IR, FX
Berkman and Bradbury	1996	Fair value of the contract/MV, gross notional value/MV	All
Fok, Carroll and Chiou	1997	Dummy=1 if derivatives used	All
Géczy, Minton and Schrand	1997	Dummy=1 if derivatives used	FX
Howton and Perfect	1998	Fair value of the contract/MV, gross notional value/MV	All, IR, FX
Gay and Nam	1998	Gross notional value /TA	All
Jalilvand	1999	Dummy=1 if derivatives used	All
Whidbee and Wohar	1999	Dummy=1 if derivatives used	FX or IR
Haushalter	2000	% of production hedged, dummy variable=1 if derivatives used	CR (oil and gas)
Allayannis and Ofek	2001	Gross notional value /TA, dummy variable=1 if derivatives used	FX
Knopf, Nam and Thornton	2002	Gross notional value / TA	All
Dolde and Mishra	2002	Gross notional value/sales, dummy=1 if derivatives used	FX
Rogers	2002	Net notional value/TA	IR + FX
Graham and Rogers	2002	Net notional value/TA	IR + FX
Rajgopal and Shevlin	2002	Quantity of reserves hedged/quantity of proven reserves held by the firm	CR (oil and gas)
Lin and Smith	2003	Dummy=1 if derivatives used	All
Dionne and Garand	2003	Delta% at the quarter end	CR (gold)
Nguyen and Faff	2003	Gross notional value/MV, dummy variable=1 if derivatives used	IR, FX
Brown, Crabb and Haushalter	2003	The quarter to quarter change in the delta percentage	CR (gold)

Bartram et al.	2004	Dummy =1 if derivatives used	All, FX, IR, CR
Lel	2004	Dummy=1 if derivatives used, gross notional value /TA	FX risk
Dionne and Triki	2004	Delta% at the quarter end	CR (gold)
Borokhovich et al.	2004	Gross notional value/sales	IR
Dionne and Triki	2005	Delta% at the quarter end	CR (gold)
Mardsen and Prevost	2005	Fair value of the contract/MV, gross notional value/MV, dummy variable=1 if derivatives used	All

Table III: Summary of variables used to measure the tax advantage of hedging

This table summarizes the different variables used in the papers reviewed to measure the convexity-tax advantage of hedging. TLCF stands for tax loss carryforward, ITC for investment tax credit, FTC for foreign tax credits, dummy for progressive for a dummy variable equals one if the firm's revenues falls in the progressive region, 0 otherwise, MV for market value, TA for the book value of total assets, ETR for effective tax rate, MTR for marginal tax rate and, DIT for deferred income taxes.

Authors Name	Year of Apparition / Publication	Variable(s) used
Nance, Smith and Smithson	1993	TLCF, ITC, dummy for progressive
Berkman and Bradbury	1996	Dummy=1 if the firm reports TLCF
Tufano	1996	TLCF/MV
Mian	1996	Dummy for progressive, dummy=1 if the firm reports TLCF, Dummy=1 if FTC reported
Fok, Carroll and Chiou	1997	ITC, TLCF
Géczy, Minton and Schrand	1997	TLCF/TA
Howton and Perfect	1998	Dummy for progressive, dummy=1if the firm reports TLCF
Gay and Nam	1998	TLCF/TA
Jalilvand	1999	Dummy=1 if the firm reports TLCF, income volatility, dummy for positive and increasing ETR, ETR
Haushalter	2000	Simulated MTR, dummy for progressive
Allayannis and Ofek	2001	Dummy=1 if the firm reports TLCF or ITC
Knopf, Nam and Thornton	2002	TLCF/TA
Rogers	2002	TLCF/TA
Graham and Rogers	2002	Simulated tax saving/sales, TLCF/TA
Dionne and Garand	2003	DIT/TA, prediction from the Graham and Smith (1999) model
Lin and Smith	2003	TLCF/TA
Dionne and Triki	2004	Simulated tax saving/sales
Bartram et al.	2004	ITC, dummy=1 if the firm reports ITC
Dionne and Triki	2005	Simulated tax saving/sales
Mardsen and Prevost	2005	Dummy=1 if the firm reports TLCF

Table IV: Summary of variables used to measure the financial distress costs

This table summarizes the different variables used in the papers reviewed to measure the financial distress costs. TA stands for the book value of total assets, MV for market value, ROA for return on assets, OI for operating income, MVE and BVE respectively for the market value and the book value of the firm's equity, dvd for dividend and, BVPS for the book value of the firm's preferred shares.

Authors Name	Year of Apparition / Publication	Variable(s) used
Nance, Smith and Smithson	1993	Leverage, interest coverage ratio
Berkman and Bradbury	1996	Leverage, interest coverage ratio, size
Tufano	1996	Leverage, cash cost
Fok, Carroll and Chiou	1997	Leverage, times interest coverage earned
Géczy, Minton and Schrand	1997	Leverage, interest coverage ratio, S&P credit rating
Howton and Perfect	1998	Leverage, interest coverage ratio, tangible assets/TA
Gay and Nam	1998	Leverage, interest coverage ratio
Jalilvand	1999	Leverage, interest coverage ratio, credit rating
Whidbee and Wohar	1999	Shareholders equity/MV
Haushalter	2000	Leverage, production costs
Allayannis and Ofek	2001	Leverage, ROA
Knopf, Nam and Thornton	2002	Leverage, interest coverage ratio
Rajgopal and Shevlin	2002	Leverage
Rogers	2002	Leverage, OI/TA
Graham and Rogers	2002	Leverage, leverage*MVE/BVE
Dionne and Garand	2003	Leverage, cash cost, dvd yield, BVPS/MV, financial constraint
Nguyen and Faff	2003	Leverage, size
Lin and Smith	2003	Leverage
Borokhovich et al.	2004	Leverage
Dionne and Triki	2004	Leverage, cash cost
Bartram et al.	2004	Leverage, interest coverage ratio, dividend
Lel	2004	Leverage, interest burden
Dionne and Triki	2005	Leverage
Mardsen and Prevost	2005	Leverage

Table V: Summary of variables used to measure the underinvestment costs

This table summarizes the different variables used in the papers reviewed to measure the underinvestment costs. R&D stands for research and development expenditures, B/M for the book to market ratio, CF for the value of the firm's cash flows, MV for market value, M/B for the market to book ratio, PPE for capital expenditures for property, plant and equipment, CAR for cumulative abnormal returns, dvd for dividend, TA for the book value of total assets and, IOS for investment opportunities set score.

Authors Name	Year of Apparition / Publication	Variable(s) used	Control for the FSS argument
Nance, Smith and Smithson	1993	R&D/MV, B/M	
Berkman and Bradbury	1996	Earnings/price, Asset growth/CF	
Tufano	1996	Explorations expenditures/MV, acquisition expenditures/MV	
Mian	1996	M/B	
Fok, Carroll and Chiou	1997	R&D/MV, B/M	
Géczy, Minton and Schrand	1997	R&D/sales, PPE/MV, B/M	Yes
Gay and Nam	1998	R&D/MV, B/M, Tobin's Q, price/earnings, market adjusted CAR	Yes
Howton and Perfect	1998	R&D/sales, CF/TA	
Whidbee and Wohar	1999	Dvd/MV	
Jalilvand	1999	M/B, dvd yield	
Haushalter	2000	Investment expenditures/MV	Yes
Allayannis and Ofek	2001	R&D/sales, M/B, dvd yield	
Graham and Rogers	2002	B/M, R&D/TA	
Rogers	2002	B/M, R&D/TA, capital expenditures/TA	
Rajgopal and Shevlin	2002	IOS (factor analysis M/B, explorations costs)	
Knopf, Nam and Thornton	2002	R&D/TA, M/B	
Brown, Crabb and Haushalter	2003	Change in the M/B	
Dionne and Garand	2003	Explorations expenditures/MV, acquisition expenditures/MV	
Nguyen and Faff	2003	M/B, liquidity, current ratio	
Lin and Smith	2003	R&D/TA	
Lel	2004	B/M	Yes

Dionne and Triki	2004	Explorations expenditures/MV, acquisition expenditures/MV	
Bartram et al.	2004	M/B	Yes
Borokhovich et al.	2004	quick ratio, B/M	
Dionne and Triki	2005	Exploration expenditures/VM	

Table VI: Summary of variables used to measure managerial risk aversion

This table summarizes the different variables used in the papers reviewed to measure managerial risk aversion related to stock and stock options compensations. % stands for percentage, Ln for the natural logarithm operator, CS for common shares, D for directors, O for officers, D&O for directors and officers, MV for market value and, # for number.

Authors Name	Year of Apparition / Publication	Variables proxying incentives from stock compensation	Variables proxying incentives from options compensation
Berkman and Bradbury	1996	% CS held by D	
Tufano	1996	Ln(MV D&O CS)	# D&O options
Géczy, Minton and Schrand	1997	Ln(MV D&O CS)	Ln(MV D&O CS obtainable upon exercise)
Gay and Nam	1998	Ln(MV D&O CS)	# D&O options
Jalilvand	1999	% CS held by top 5 O	
Haushalter	2000	Ln(MV D&O CS), % CS held by D&O	# D&O options, # options per D&O, # options per O, MV CEO options/CEO salary + bonus
Allayannis and Ofek	2001	% CS held by the CEO	# CEO options/CS outstanding
Graham and Rogers	2002	Delta/ (CEO salary + bonus)	Vega/CEO salary + bonus
Knopf, Nam and Thornton	2002	Ln(MV CEO CS), Ln(Delta)	Ln(# CEO options), Ln(MV of CEO CS obtainable upon exercise), Ln(Vega)
Rajgopal and Shevlin	2002		Vega
Rogers	2002	Ln(MV CEO CS)	Vega/Delta, # CEO options
Nguyen and Faff	2003	% CS held by D&O	# D&O options/CS outstanding
Bartram et al.	2004		Dummy =1 if stock options are reported in the proxy statement
Borokhovich et al.	2004		# top 5 O options/total salary + bonus
Dionne and Triki	2004	MV D&O CS	# D&O options
Dionne and Triki	2005	# CEO CS	MV of CEO options
Mardsen and Prevost	2005	% CS held by D&O	

Table VII: Summary of variables used to measure information asymmetry

This table summarizes the different variables used in the papers reviewed to measure the extent of information asymmetry about the firm. % stands for percentage, CS for common shares, # for number, Ln for the natural logarithm operator and, TA for the book value of total assets.

Authors Name	Year of Apparition / Publication	Variable (s) used
Géczy, Minton and Schrand	1997	% CS held by institutions, # of analysts following the firm
Haushalter	2000	Dummy equal=1 if the firm's debt is rated by S&P
Graham and Rogers	2002	% CS held by institutions
Rogers	2002	% CS held by institutions, Ln(TA)
Lin and Smith	2003	Analysts forecast accuracy
Dionne and Triki	2004	% CS held by institutions
Dionne and Triki	2005	% CS held by institutions

Table VIII: Summary of variables used to measure concentration of the ownership structure

This table summarizes the different variables used in the papers reviewed to measure the firm's ownership concentration. % stands for percentage, CS for common shares, # for number, Ln for the natural logarithm operator and, MV for market value.

Authors Name	Year of Apparition / Publication	Variable (s) used
Tufano	1996	% CS held by non managerial blocks (>10%)
Fok, Carroll and Chiou	1997	% CS held by insiders, % CS held by institutions
Whidbee and Wohar	1999	% CS held by CEO, % CS held by outsiders, % CS held by institutions
Haushalter	2000	# outside blockholders (>5%)
Knopf, Nam and Thornton	2002	% CS held by outsiders (>5%)
Borokhovich et al.	2004	% votes held by insiders, % votes held by blockholders(>5%),% votes held by banks
Lel	2004	Dummy=1 if inside blockholders (>10%), dummy=1 if outside blockholders, dummy=1 if institutional blockholding, wedge, % managerial shareholding, Ln(MV managerial shareholdings)
Mardsen and Prevost	2005	% CS held by blockholders (>5%)

Table IX: Summary of variables used to measure the board characteristics

This table summarizes the different variables used in the papers reviewed to measure the board characteristics, % stands for percentage and, COB stands for chief of the board.

Authors Name	Year of Apparition / Publication	Variable (s) used
Whidbee and Wohar	1999	% outsiders in the board
Dionne and Triki	2004	% outsiders in the board, dummy COB=CEO
Lel	2004	Index in the spirit of Gompers et al (2003)
Borokhovich et al.	2004	Outsiders-insiders /board size, board size, dummy=1 if bank executive in the board
Mardsen and Prevost	2005	% outsiders in the board, outside directors*dummy if Tobin's Q > sample median
Dionne and Triki	2005	Too many variables to fit in a table

Table X: Summary of variables used to measure substitutes to hedging with derivatives

This table summarizes the different variables used in the papers reviewed to measure substitutes to hedging with derivatives. BVCD stands for the book value of convertible debt, BVPS for the book value of preferred shares, dvd for dividend, Ln for the natural logarithm operator, MV for market value, TA for the book value of total assets, CD for convertible debt and, FDD for foreign denominated debt.

Authors Name	**Year of Apparition / Publication**	**Variable (s) used**
Nance, Smith and Smithson	1993	BVCD/MV, BVPS/MV, current ratio, dvd yield
Tufano	1996	diversification, quick ratio
Berkman and Bradbury	1996	Ln(quick ratio), dvd payout ratio, quasi equity
Fok, Carroll and Chiou	1997	BVCD/MV, BVPS/MV, current ratio, dvd yield, dummy=1 if the firm is defined as a multinational corporation
Géczy, Minton and Schrand	1997	BVCD/MV, BVPS/MV, quick ratio, dvd payout ratio
Gay and Nam	1998	BVCD/MV, BVPS/MV
Howton and Perfect	1998	Quick ratio, BVPS/TA, BVCD/TA
Jalilvand	1999	Quick ratio, dvd payout, dummy=1 if the firm uses CD
Haushalter	2000	Dvd payout ratio, diversification, cash holdings
Rajgopal and Shevlin	2002	Dvd payout, quick ratio
Knopf, Nam and Thornton	2002	Dvd yield, BVPS/TA
Graham and Rogers	2002	Dvd yield, quick ratio
Nguyen and Faff	2003	Dvd yield
Dionne and Garand	2003	Quick ratio
Lin and Smith	2003	Quick ratio
Lel	2004	Dvd dummy, BVCD/TA, FDD ratio, diversification
Dionne and Triki	2004	Quick ratio
Bartram et al.	2004	Quick ratio, dummy=1 if the firm issued FDD
Mardsen and Prevost	2005	Ln(current ratio), dvd yield

Table XI: Summary of variables used to measure the firm's exposure

This table summarizes the different variables used in the papers reviewed to measure the firm's exposure. MV stands for market value, FX for foreign exchange risk, FI for foreign income, FS for foreign sales, FA for foreign assets and, TA for the book value of total assets.

Authors Name	Year of Apparition / Publication	Variable (s) used
Fok, Carroll and Chiou	1997	Unrelated diversification
Géczy, Minton and Schrand	1997	Pre-tax FI/sales, FS/sales, FA/TA
Howton and Perfect	1998	Dummy=1 if the firm reports FI
Jalilvand	1999	Dummy=1 if the firm reports foreign operations, dummy=1 if the firm operates in a high risk exposure industry
Whidbee and Wohar	1999	The absolute value of 12-month GAP/MV, commercial and industrial loans/MV, unused commitments/MV
Allayannis and Ofek	2001	FS/sales, total trade/total production
Dolde and Mishra	2002	FX exposure
Graham and Rogers	2002	Floating debt/total debt, FS/sales
Rajgopal and Shevlin	2002	Oil and gas sales/sales
Brown, Crabb and Haushalter	2003	Change in the spot gold price, change in the implied volatility of the gold futures contract
Bartram et al.	2004	Dummy =1 if the firm reports FA, FI or FS
Lel	2004	FS/sales
Mardsen and Prevost	2005	Interest rate volatility, exchange rate volatility

Table XII: Summary of variables used to measure size

This table summarizes the different variables used in the papers reviewed to measure the firm's size. MV stands for market value, TA for the book value of total assets, Ln for the natural logarithm operator and, MVE for the market value of equity.

Authors Name	Year of Apparition / Publication	Variable (s) used
Nance, Smith and Smithson	1993	MV
Mian	1996	MV
Tufano	1996	MV, reserves
Fok, Carroll and Chiou	1997	MV, TA, sales
Géczy, Minton and Schrand	1997	MV
Gay and Nam	1998	Ln(MV)
Howton and Perfect	1998	MVE
Jalilvand	1999	Ln(MV)
Whidbee and Wohar	1999	Ln(MV)
Haushalter	2000	MV
Allayannis and Ofek	2001	Ln(TA)
Graham and Rogers	2002	Ln(TA)
Knopf, Nam and Thornton	2002	Ln(MV)
Rajgopal and Shevlin	2002	Ln(TA)
Brown, Crabb and Haushalter	2003	Change in TA
Dionne and Garand	2003	Reserves
Lin and Smith	2003	Ln(TA)
Bartram et al.	2004	Ln(MV)
Borokhovich et al.	2004	Ln(MVE)
Dionne and Triki	2004	Ln(sales)
Lel	2004	Ln(TA)
Mardsen and Prevost	2005	Ln(MV)